Scientific Method

1. Ask a question (Make observation)
2. Do some research
3. Form a Hypothesis—**MUST BE TESTABLE!!**
   "A possible explanation for a phenomenon."
4. Test Hypothesis/collect data (experiment time!)
5. Analyze data
6. Draw Conclusions (Accept/Reject Hypothesis)

Form a Hypothesis

- **Hypothesis**- a ***testable explanation*** of an observation.
- A hypothesis is ***NOT just an educated guess*** about what you think will happen. It must be able to be tested!

Form a Hypothesis 2

- We write the hypothesis in an **If-Then statement**

  ex: **If** the amount of fertilizer is increased, **then** the height of the plant will increase.

Variables in an Experiment

Dependent Variable – what is being measured (data)

Independent Variable- manipulated by the scientist; what is adjusted; changed

Constants – factors that stay the same throughout the experiment (*ex: amount of food, water, etc.*)

Controls- baseline for comparison that does not change during the experiment and does not affect the dependent variable

DRY MIX

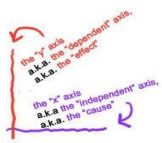
One way to remember which data goes on which axis is the acronym **DRY MIX**.

D.R.Y.

D- Dependent
R- Responding
Y- Y-axis

M.I.X.

M- Manipulated
I- Independent
X- X-axis



Form a Hypothesis 3

- The Independent Variable goes after the "If"

I.V.

If the amount of fertilizer is increased,
then the height of the plant will increase.

Form a Hypothesis 4

- The **Dependent Variable** goes after the "Then"

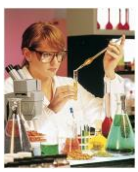
If the amount of fertilizer is increased,
then the height of the plant will increase.

D.V.

What is Biology?

- It is the study of life.
- Branch of science
  - A way of understanding nature.
- A human endeavor
  - An attempt to understand, explain, integrate and describe the world of living things.

Why Study Biology?




- Two important reasons for studying Biology:
  1. Biology is relevant to our everyday experience
     - Medical advances
     - Addressing needs of growing human population
     - Challenges of decreasing rate of biodiversity
     - Biotechnology advances

Why Study Biology?

2. Biology can be controversial
   - Examples:
     - Dealing with endangered species?
     - Use of human fetal tissue in biomedical research?
     - Safety of irradiated foods?


In Big Advance in Cloning, Biologists Create 50 Mice

Indicates More Rapid Progress Than Imagined

By GINA KOLATA

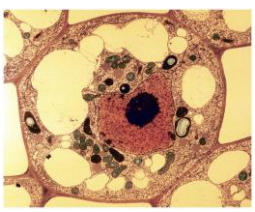
The New York Times

What is Life?

- Living organisms:
  - Highly organized and complex.
  - Are composed of one or more cells.
  - Contain a blueprint of their characteristics.
  - Acquire and use energy.
  - Carry out and control numerous reactions.

What is Life?

- Living organisms:
  - Grow.
  - Maintain constant internal environment.
  - Produce offspring.
  - Respond to environmental changes.
    - May evolve.

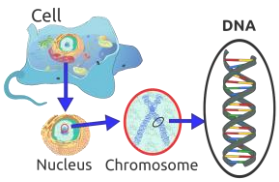


Biology is a Branch of Science

- Both an activity and body of knowledge.
- A way of understanding the natural world.
  - Scientists make predictions and test those predictions.

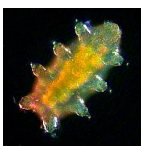
Major Themes in Biology

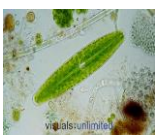
- Evolution by Natural Selection
- Inheritance
- Cells
- Biological Classification
- Homeostasis
- Ecosystems



Microscope Fun Facts

- **Microscopes made it possible to observe living organisms that most people didn't even know existed**

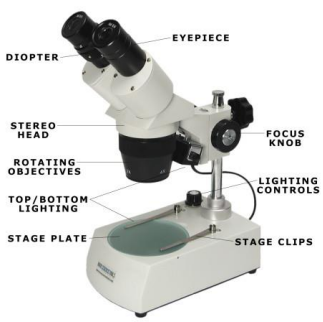




Microscopes

- **Electron Microscope - uses beam of electrons**
  - **Scanning - study detailed surface (ex: viruses)**
  - **Transmission - study of internal structures Light**
- **Dissecting Microscope**
  - **Low magnification used for examining or dissecting *larger items* and organisms**
- **Light Microscope**
  - **visible light passes through the specimen, then lenses enlarge/magnify the image**
  - **Used to see *very small items (cells ect)* at great magnification**

Dissecting Scope

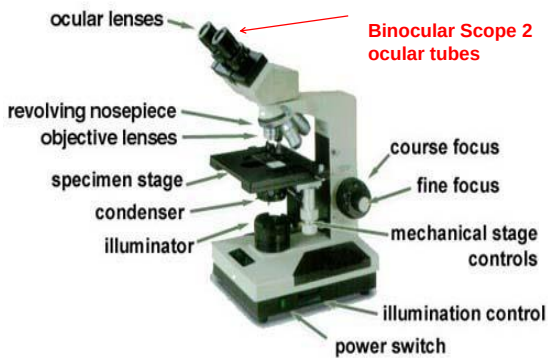


Dissection **VS** **Compound Microscopes**

Dissection
1 lens
No stage- 2 ocular
Examine items you can
See with naked eye

Compound
1 ***OR*** 2 lens
Has a stage
Examine items you can't see with the naked eye

Parts of a Compound Microscope



Microscope Magnification

Microscopes magnify small objects we can not see or can't see in detail with the naked eye

The degree of magnification depends on the lens you are looking through and the scope you are using.

Dissection scopes magnify usually between 10-30X

Compound light scopes 40-400X

Figure out magnification:

Ocular lens (always the same) X Objective lens

10 X 20 = 200X

Magnification changes occur depending on which obj lens

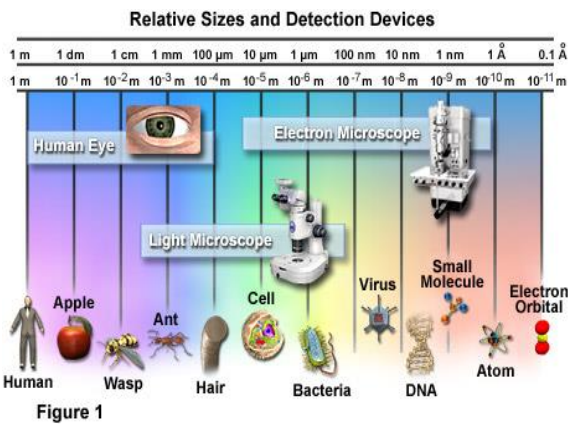


Figure 1

Cells and Cell Theory

https://www.youtube.com/watch?v=4OpBylwH9DU

- **Many scientists contributed to the cell theory.**
- **The cell theory grew out of the work of many scientists and improvements in the microscope.**

Be able to recognize names, you do not have to be able to spell them correctly

- **The cell theory grew out of the work of many scientists and improvements in the microscope.**
  - **Many scientists contributed to the cell theory.**
  - **More was learned about cells as microscopes improved.**

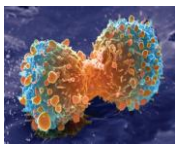
The cell theory is a unifying concept of biology.

Leeuwenhoek observed and drew these diagrams from pond water

- Early studies led to the development of the cell theory.

The Cell theory has three principles.

1. ***All organisms are made of cells.***
2. ***All existing cells are produced by other living cells.***
3. ***The cell is the most basic unit of life.***


2 types of organisms– In terms of cells they are made of

Unicellular organisms: are composed of one cell and all of life's activities occur within that single cell.

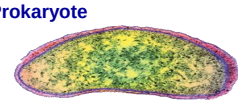
Multicellular organism: made of 2+ cells, each cell carries on most of the major functions of life.

There are two cell types: eukaryotic cells and prokaryotic cells.

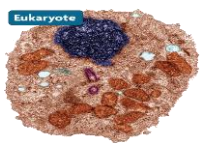
Common Features

- **Both are enclosed by a plasma membrane.**
- **Both are filled with cytoplasm.**
- **Both types contain DNA & *ribosomes***
- **Can be either plant or animal cell**

Prokaryote



Bacterium
(colored SEM; magnification 8800x)



Prokaryotic cells

(pro=before kary=nucleus)

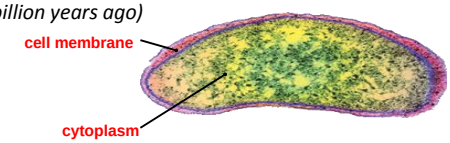
These include bacteria and archaea

Don't have a nucleus

No membrane-bound organelles.

Prokaryotes: simpler organisms, Oldest single celled organisms evolved 3.5 – 3.8 bya

(billion years ago)



Bacterium
(colored SEM; magnification 8800x)

Eukaryotic Cells

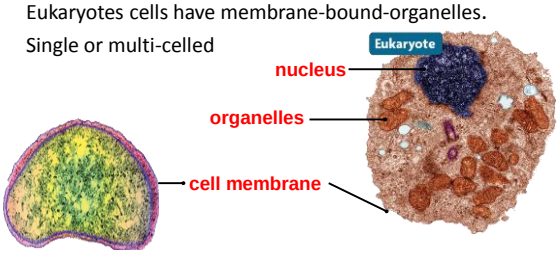
(eu=true kary=nucleus)

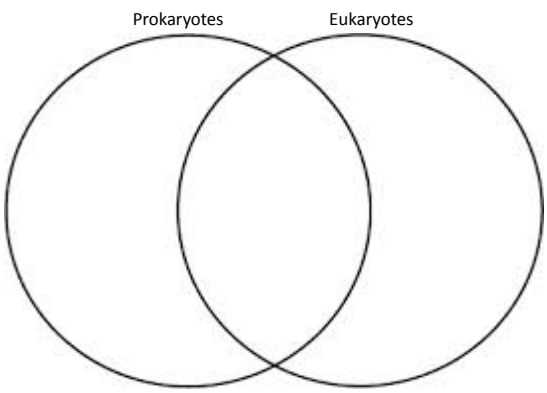
Eukaryotes: larger more complex organisms (you and me), evolved 1.7 bya from prokaryotes

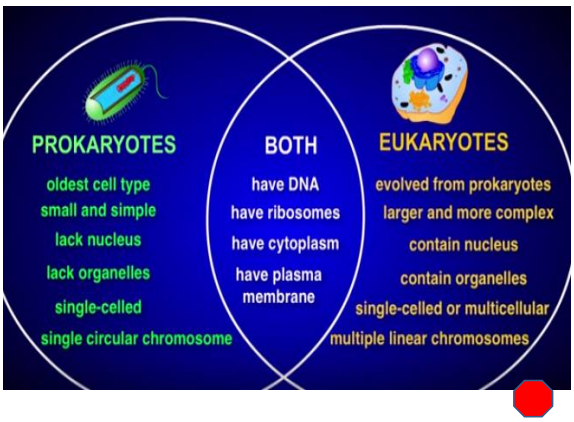
Eukaryotic cells have a true nucleus.

Eukaryotes cells have membrane-bound-organelles.

Single or multi-celled

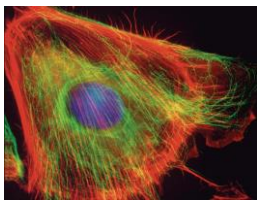






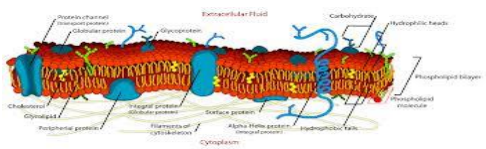
Cell Structure and organelles

- The cytoskeleton is the internal structure of the cell.
  - supports and shapes
  - helps position and transport organelles
  - provides strength
  - assists in cell division
  - aids in cell movement



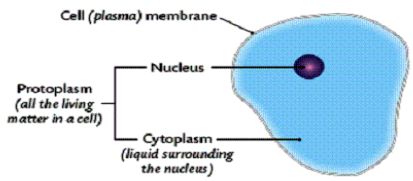
Cell Structure and organelles

Cell membrane (aka plasma membrane) is the cell structure that encloses the cell and regulates the passage of materials between the cell and its environment; also aids in protection and support of the cell. Bi-layer of phospholipids. Lines inside of cell wall in plants



Cell Structure and organelles

Protoplasm: Everything in the cell including nucleus.



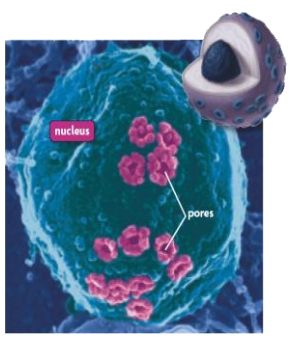
Cytoplasm: All material between the cell membrane and the nucleus

Organelles involved in making/transporting proteins

The nucleus stores genetic information, control center of the cell.

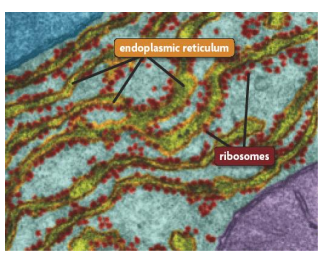
Nuclear envelope
Membrane that surrounds and protects nucleus

Nuclear Pores:
Openings in nuclear membrane that allows material to pass in and out.



Organelles involved in making/transporting proteins

endoplasmic reticulum the main function is the folding of proteins.

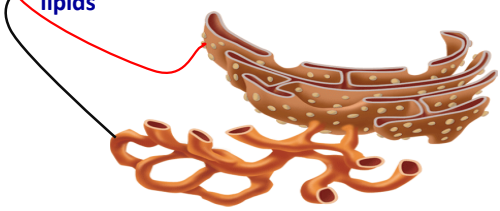


Organelles involved in making/transporting proteins

Two types of ER.

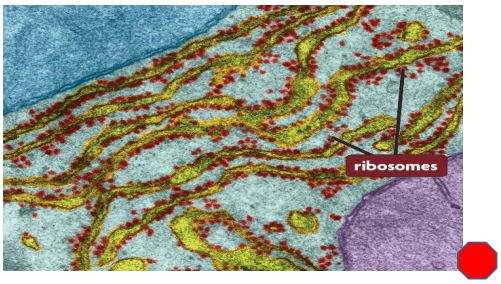
Rough E.R.: Studded with ribosomes on the surface.

Smooth E.R.: No ribosomes attached. Produces lipids



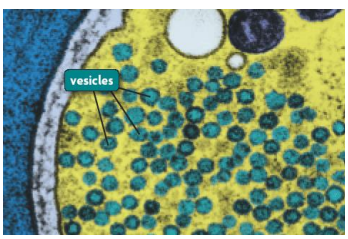
Organelles involved in making/transporting proteins

Ribosomes link amino acids to form proteins. Some on Rough ER, some free in cytoplasm.



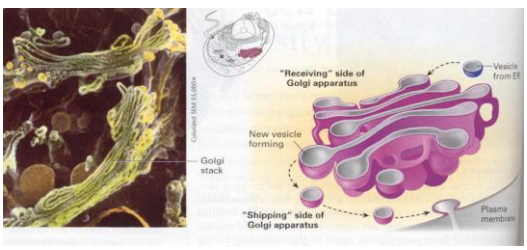
Organelles involved in making/transporting proteins

Vesicles are membrane-bound sacs that hold materials. Some hold/transport proteins. Others transport things like waste out of cells (excretion)



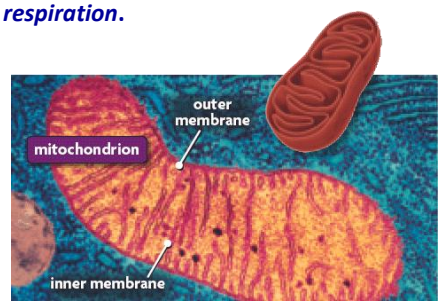
Organelles involved in making/transporting proteins

Golgi apparatus modifies, collects, packages, and distributes molecules within the cell or outside the cell. Looks like stacks of flattened sacs



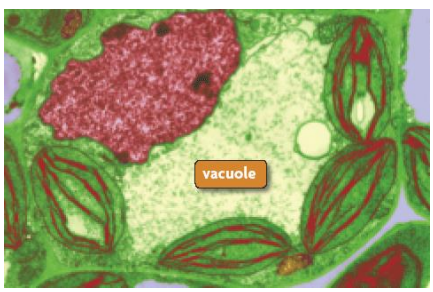
Organelles with various functions

Mitochondria supply energy to the cell, ***site of respiration***.



Organelles with various functions

Vacuoles are fluid-filled sacs that hold materials. Many in cells. "Storage unit"

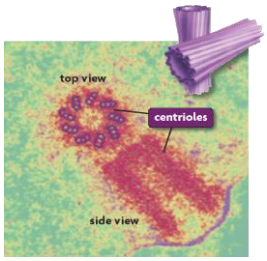


Organelles with various functions

Centrioles are tubes found in the centrosomes.

Help divide DNA in cell division

Form cilia and flagella.

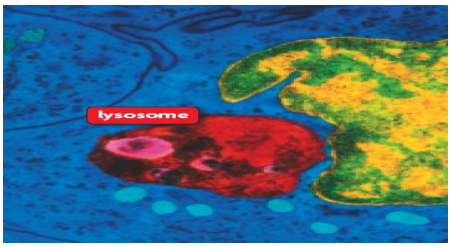


Organelles with various functions

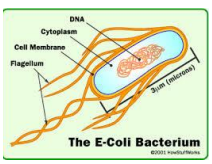
Lysosomes contain enzymes to digest material.

Can act as a suicide or kill switch for cells.

Mainly animal cells only, very rarely in plant cells



Organelles only in animal cells



FLAGELLA – long, thin, whip – like structures with a core of microtubules

Move with an "S-shaped" movement

CILIA – shorter and more numerous, bundles of microtubules "back and forth" movement

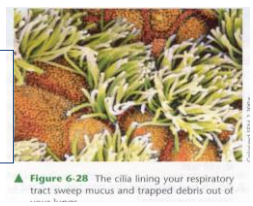
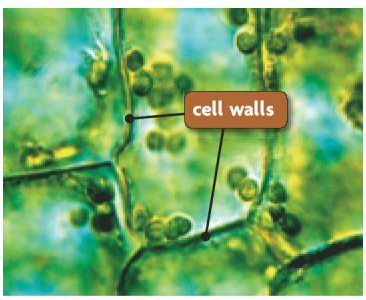


Figure 6-28 The cilia lining your respiratory tract sweep mucus and trapped debris out of

Organelles in plant cells only

Cell wall provides rigid support. Gives rigidly or crunchiness to plants (think celery)

http://learn.genetics.utah.edu/content/begin/cells/insideacell/



Organelles in plant cells only

Chloroplasts convert solar energy to chemical energy.